



ADULT STEELHEAD RETURNS TO DWORSHAK NFH IN 2008-2009 AND PROGNOSIS FOR 2009-2010

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Introduction

Dworshak National Fish Hatchery (NFH) is located at the confluence of the North Fork and the main stem of the Clearwater River near Ahsahka, Idaho approximately 811 km from the Pacific Ocean. Construction of the hatchery was included in the authorization for Dworshak Dam and Reservoir (Public Law 87-847, October 23, 1962) to mitigate for losses of steelhead (*Oncorhynchus mykiss*) from the North Fork Clearwater River caused by the dam and reservoir.

The hatchery was designed and constructed by the U.S. Army Corps of Engineers and was administered and operated by the U.S. Fish and Wildlife Service following completion of the first phase of construction in 1969 until 2007. Since 2007, DNFH has been co-managed by U.S. Fish and Wildlife Service and the Nez Perce Tribe. In addition to steelhead, DNFH also rears production of spring Chinook salmon (*O. tshawytscha*) and coho salmon (*O. kisutch*), reported separately.

Starting in 1969, the hatchery had 25 Burrows ponds on a single reuse system and 59 other Burrows ponds on single-pass water. In 1972, a second phase of construction placed all these ponds on three reuse systems with the option of operating on either reuse or single-pass. In 1986, the oldest system (25 ponds) was taken off reuse and put on single-pass. In 2004, a rehabilitation project was completed that again allowed reuse in this system.

The North Fork Clearwater River (NFCWR) steelhead stock maintained by Dworshak NFH is unique. At maturity, males and females of this particular stock of "B" run steelhead average about 91 cm (36 inches) and 82 cm (33 inches) in length, respectively. Spawning stock is comprised of three age classes; 1-, 2-, and 3-ocean fish. This nomenclature refers to the number of complete years fish have spent rearing in the ocean. Fish are actually two years older than this system indicates, as they are reared for one year in the hatchery and spend another year migrating to and from the ocean.

Most adult "B" run steelhead leave the ocean to return to the Columbia River in August through September. This is usually later than the smaller "A" run steelhead. "A" run steelhead are destined for lower Clearwater tributaries and the Salmon River. Some of the Clearwater "B" run steelhead actually arrive at Dworshak NFH in the fall (same year they entered freshwater). The remainder of the run may hold in the Snake and Clearwater rivers where they over-winter until their final run into the hatchery in late winter and early spring (of the year after they entered freshwater). The Dworshak NFH trap is operated during the fall to insure inclusion of adequate numbers of early arriving steelhead (~500 adults) into the hatchery brood stock. The trap is again operated, intermittently, from February through April to capture brood stock from the mid and late portions of the run. Steelhead are also trapped at Kooskia NFH located about 1.5 miles east of Kooskia, Idaho, near the confluence of Clear Creek and the Middle Fork Clearwater River. In low return years these steelhead are available for broodstock use at Dworshak NFH, although this has not occurred since 1995 and normally they are recycled to the South Fork Clearwater fishery.

Historical Clearwater River Steelhead.

Based on trap records at the Lewiston Dam, steelhead moved into the Clearwater River during both fall and spring (Miller 1987). Fall migration started September, peaked in October, and stopped when water temperatures declined to about 3°C. The spring movement began when water temperatures reached above 4°C, usually peaking in April (Figure 1) and was correlated with spring flows. The spring component of the Clearwater River steelhead run overwintered downstream from Lewiston while the early-arriving fish overwintered between Spalding and Kooskia (as determined from tag returns from sport fishery). Fall movements were not correlated with flows.

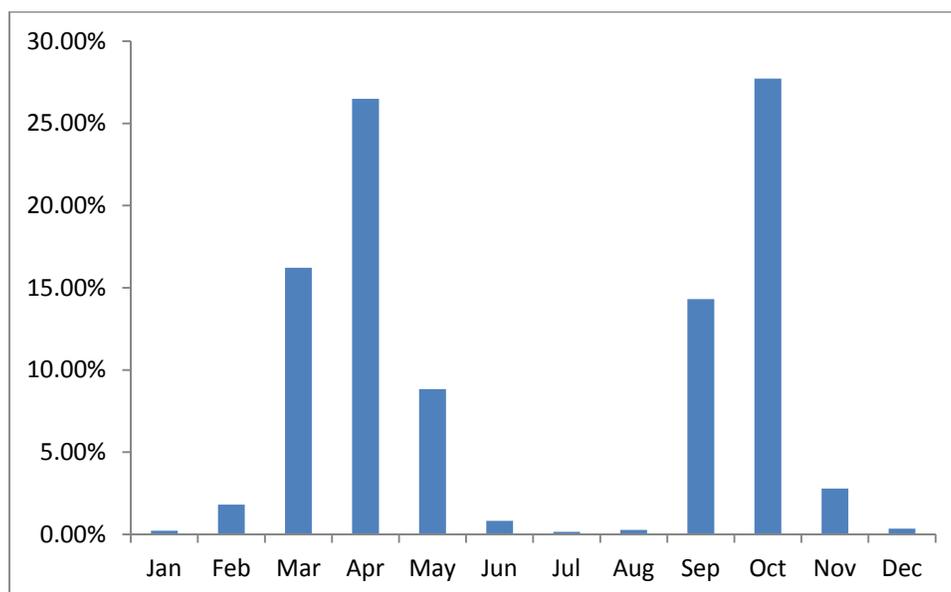


Figure 1. Mean monthly percentage of adult steelhead counted at Lewiston Dam from 1951 to 1971.

Scale analysis from 510 steelhead collected at the Lewiston Dam in 1952 suggested that 27% migrated to the ocean as 1 year olds, 59% when two years old and 14% after rearing in freshwater for three years (Whitt 1954). The percentages of these fish that reared 1, 2, and 3 years in the ocean were estimated to be 61, 38 and 1%, respectively. Mean fork lengths for the 1-, 2-, 3-ocean fish were 65, 86, and 102 cm, respectively. Females made up 64% of the sample, a ratio of 1.8 females per male. Whitt (1954) stated that the female steelhead averaged about one inch (2.54 cm) longer than males. Keating (1958) provided additional length distributions for steelhead sampled at Lewiston Dam, for 1955-56 and 1956-57. Ages of fish were not determined, but the size-frequency curve for 1955-56 resembled that observed in 1951-52, dominated by 1-ocean fish, while the peak abundance during 1956-57 was in the size group for 2-ocean fish.

The first years of broodstock collection, 1968 through 1971 also provide information on the original population of the North Fork Clearwater River B run steelhead. For 1968-69, the first year of broodstock collection, 3,101 adults were collected from North Fork Clearwater River, October

1968 to May 1969, 2,902 were retained. Female:male ratio was 2.5:1. Females averaged 81.8 cm length, 5.3 kg weight while males averaged 83.6 cm and 6.3 kg. Fecundity averaged 6,112 eggs per female. For the 1970 and 1971 broodyears, 2,856 and 2,312 steelhead were collected at the trap, respectively. Mean lengths and weights were 82.8 cm and 5.3 kg for females, 83.3 cm and 5.4 kg for males. Fecundity averaged 6,428 and 5,360 eggs per female, respectively, for the two years. Ages of these fish varied among years on the proportional makeup of 2- and 3-ocean components. On average returning wild steelhead were 57% 2-ocean, 39% 3-ocean for the 1969-1972 broodyears (Table 1; Pettit 1976).

Table 1. Mean ocean and freshwater (FW) age distribution for wild North Fork steelhead used for broodstock from 1969 to 1972 as determined from scale analysis. Source: Pettit (1976).

Year	% 1-Ocean	% 2-Ocean	% 3-Ocean	% 4-Ocean	% 1-FW	% 2-FW	% 3-FW
1969	4.5	70.1	25.3	0.0	10.0	82.8	7.2
1970	0.0	32.4	61.7	5.9	17.7	72.6	9.8
1971	2.2	51.1	46.7	0.0	2.2	66.7	31.1
1972*	0.0	54.6	45.5	0.0	14.6	67.3	18.2
All	2.6	57.0	39.0	1.4	11.7	76.4	11.9

*Excluded known returning hatchery fish.

Summer steelhead smolt releases from Dworshak NFH began in 1970. The first adults from released smolts returned to the hatchery in 1972. The 2008-2009 return marked the 37th year that artificially spawned North Fork Clearwater River steelhead have returned to Dworshak NFH (Table 2).

2008-2009 Adult Returns

A total of 4,350 steelhead were collected at the DNFH trap during fall of 2008 and spring 2009 (Table 2). The Dworshak NFH ladder was opened 8 October, and then again 15 October 2008 to collect early returning steelhead. A total of 513 (12% of total broodstock) steelhead were collected during the approximately 30 hrs of trap operation, a catch rate of 17.2 fish per hour (Figure 2), over three times the rate reported during the previous year. The fish ladder was operated again to collect adult coho salmon broodstock for the Nez Perce Hatchery. During this operation, 477 steelhead were incidentally caught (10.4 fish/hr). Those fish were not included in the 4,350 DNFH steelhead broodstock rack collection. All steelhead were released to the mainstem Clearwater River. The fish ladder was re-opened for steelhead collection on 17 February 2009 and operated intermittently on 9 separate days until 21 April 2009. A total of 3,833 adult steelhead entered the ladder during almost 15 hrs of operation. By month, we collected 743 (17%) steelhead in February, 2,526 (58%) in March, and 563 (13%) in April. Trapping rates ranged from a high of 3,000/hr on 25 March to a low of 49.5/hr during 15-20 April, and averaged a little under 844 fish/hr during the spring. Trapping rate values in 2008-2009 were about an order of magnitude higher than those observed during 2007-2008.

Table 2. Number of steelhead returning to Dworshak NFH, estimates of hatchery fish harvested, and total hatchery returns to the Clearwater River, Idaho, 1972-2008 (1972-73 to 1983-84 data based on Pettit (1985)).

Return year ¹	Number Back to Dworshak NFH	Estimated Clearwater Sport Harvest ²	Estimated North Fork Tribal Harvest ³	Unharvested Dworshak Hatchery Fish ⁴	Total Returning to Clearwater River
1972-73	9,938	2,068	-	0	12,006
1973-74	7,910	2,320	-	0	10,230
1974-75	1,698	N.S. ⁵	290	0	1,988
1975-76	1,858	N.S. ⁵	430	0	2,288
1976-77	3,100	N.S. ⁵	410	0	3,510
1978-79	4,939	4,610	(500) ⁶	0	10,049
1977-78	12,272	14,000	(1,000) ⁶	0	27,272
1979-80	2,519	N.S. ⁵	1,250	300	4,069
1980-81	1,968	4,510	(1,000) ⁶	500	7,978
1981-82	3,054	1,665	(1,000) ⁶	0	5,719
1982-83	7,672	13,967 ⁷	(1,500) ⁶	0	23,139
1983-84	3,284	6,500	(500) ⁶	100	11,384
1984-85	14,018	19,410	(1,500) ⁶	2,700	37,628
1985-86	4,462	7,240	1,471	1,800	15,002
1986-87	5,286 ⁸	15,679	4,210	3,000	28,175
1987-88	3,764	8,766	1,478	2,000	16,008
1988-89	6,041	11,332	1,242	3,700	22,315
1989-90	10,630	27,953	1,710	3,650	43,944 ⁹
1990-91	7,876	12,974	1,211	2,250	24,311
1991-92	3,700	10,415	1,326	1,650	17,091
1992-93	7,900	19,351	1,184	3,368	31,803
1993-94	3,757	11,538	675	1,457	17,427
1994-95	1,394	5,954	730	1,307	9,385
1995-96	4,480	2,319	992	1,315	9,106
1996-97	2,980	4,926	513	779	9,198
1997-98	3,601	7,611	145	479	11,836
1998-99	5,419	8,774	1,007	1,137	16,337
1999-00	2,882	7,177	1,000	720	11,779
2000-01	6,411	12,230	(1,000) ⁶	513	20,154

Table 2. Continued.

Return year ¹	Number Back to Dworshak NFH	Estimated Clearwater Sport Harvest ²	Estimated North Fork Tribal Harvest ³	Unharvested Dworshak Hatchery Fish ⁴	Total Returning to Clearwater River
2001-02	7,733	22,774 ¹⁰	(1,000) ⁶	774	32,281 ¹⁰
2002-03	5,244 ⁸	25,030 ¹⁰	1,118	830	32,222 ¹⁰
2003-04	3,767 ⁸	20,806 ¹⁰	(1,336) ⁶	855	26,764 ¹⁰
2004-05	4,362 ⁸	19,252 ¹⁰	1,331	280	25,225 ¹⁰
2005-06	3,243 ⁸	14,916 ¹⁰	1,470	457	20,086 ¹⁰
2006-07	3,514 ⁸	13,301 ¹⁰	(1,000) ⁶	840	18,655
2007-08	3,374 ⁸	13,289	(1,470) ⁶	71	18,204
2008-09	4,350 ⁸	27,772	(1,470)	473	34,065

Table 1. Footnotes;

¹Return year is from October through May.

²Estimates of sport harvest in the Clearwater River provided by Idaho Department of Fish and Game.

³Estimates of tribal harvest in the Clearwater River provided by Nez Perce Tribe Department of Fishery, except as noted by Footnote 6.

⁴Estimated by using the return percentage to Kooskia NFH, applied to returning II-oceans from offsite releases.

⁵N.S. = no sport fishing season.

⁶() guesstimate on tribal harvest by authors.

⁷Pettit, IDFG, Lewiston, Idaho (personal communication) included an additional 2,000 fish in harvest from Snake River for a total of 15,967.

⁸Ladder was operated intermittently for broodstock management.

⁹We believe the sport estimate of 27,953 is about 8,000 too high and the total number of Dworshak steelhead to the Clearwater River was in the range of 32,000 to 35,000.

¹⁰Sport harvest estimates have been modified from previous year's reports to account for only Dworshak's contribution to the steelhead harvest in the Clearwater River.

We collected 22 adult steelhead that were not adipose fin clipped. All 22 of these fish were immediately transported and released upstream in the main stem Clearwater River just upstream from the North Fork, in accordance with the NMFS FCRPS Biological Opinion. There were 15 mortalities of the fish trapped, resulting in a total of 4,313 adult steelhead available for the 2009 broodstock.

Age and Sex Composition

Age class of returning adult steelhead were estimated using a fork length classification developed previously using known-aged (coded-wire tagged) fish that returned to Dworshak NFH (Table 3). Based on our length model, the 2008-09 brood was 11% 1-ocean fish ("jacks"), 87% 2-ocean, and 2% 3-ocean fish (Table 4). Fish collected were 32% male and 68% female, a ratio of 2.1:1. By sex, the breakdown was 28% 1-ocean, 67% 2-ocean, and 5% 3-ocean for males, and 2% 1-ocean, 97% 2-ocean, and 1% 3-ocean returns for females (Table 4). There were 14 adult steelhead in this group that had received PIT tags as smolts. Ocean ages based on PIT records for the 14 fish agreed with those estimated from fork lengths. There were 341 adult steelhead that returned with a

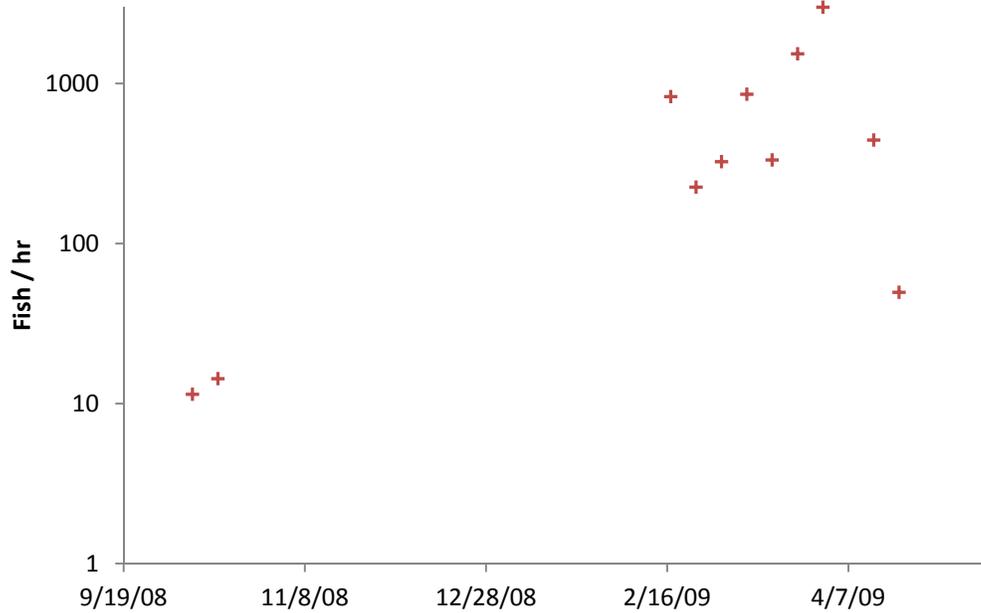


Figure 2. Trapping rate (fish/hr) for adult steelhead collected at Dworshak National Fish Hatchery for broodstock during fall 2008 and spring 2009. Each point represents one to three days trapping effort. Dates represent date fish collected in trap were processed, which varied from times trap was operated. Note logarithmic scale on y-axis.

Table 3. Length-age classifications used for returning DNFH steelhead.

Ocean age	Fork length (cm)	
	Females	Males
1-Ocean	< 68	<73
2-Ocean	68-90	73-92
3-Ocean	> 91	>92

coded-wire-tag (CWT) that could be used to identify their brood year of origin. Overall, ages based on our length criteria (Table 5) were correct for 95.6% of CWT steelhead. For males and females, ages were correctly classified 89.6% and 97.4% of the time, respectively. The largest deviation occurred for 2-ocean males that were incorrectly classified as 1-ocean (jack) returnees.

The trap at Kooskia National Fish Hatchery (KNFH) was operated from 16 March until 8 April 2010. Steelhead were processed on 31 March and 8 April 2010. A total of 221 adult steelhead were collected at KNFH (Table 6). These 221 fish included 213 hatchery fish (144 females, 69 males) and 8 natural (5 females, 3 males) steelhead. Ages were 8 (11.1%) 1-ocean, 60 (83.3%) 2-ocean, and 4 (5.5%) 3-ocean fish for males and 1 (0.7%) 1-ocean and 148 (99.3%) 2-ocean fish for females. All hatchery fish collected at KNFH were released into the South Fork Clearwater River to spawn and natural fish were released upstream of the weir in Clear Creek (Table 6).

Table 4. Adult steelhead broodstock returns by sex, age, and return time at Dworshak National Fish Hatchery rack, 2008-2009.

Ocean Age Class by Run Time	Males	Females	Total
Fall Collection (10/8 to 10/15)			
I-Ocean	44	5	49
II-Ocean	187	273	460
<u>III-Ocean</u>	7	1	8
Total	238	275	517
Spring Collection (2/28 to 5/02)*			
I-Ocean	350	67	417
II-Ocean	743	2,596	3,339
<u>III-Ocean</u>	64	13	77
Total	1,157	2,676	3,833
Combined Total*			
I-Ocean	394	72	466
II-Ocean	930	2,869	3,799
<u>III-Ocean</u>	71	14	85
Total Measured Rack Return*	1,395	2,955	4,350

* Intermittent ladder operation during Spring Run for broodstock management.

Table 5. Comparative known (rows) and estimated (columns) ocean ages for adult steelhead with CWTs collected at Dworshak National Fish Hatchery during 2008-2009.

ALL STEELHEAD				
Age based on length				
CWT Age	1-O	2-O	3-O	
1-O	22	5	0	Correct = 95.6%
2-O	7	302	3	
3-O	0	2	0	
MALES				
Age based on length				
CWT Age	1-O	2-O	3-O	
1-O	18	1	0	Correct = 89.6%
2-O	7	77	3	
3-O	0	0	0	
FEMALES				
Age based on length				
CWT Age	1-O	2-O	3-O	
1-O	2	4	0	Correct = 97.4%
2-O	0	225	0	
3-O	0	2	0	

Table 6. Rack returns and ocean age class structure for hatchery steelhead and naturals captured at Kooskia NFH, 1995-2009.

Return year	I-Ocean	II-Ocean	III-Ocean	Total Hatchery	Naturals
1995	20	381	20	421	48
1996	72	307	6	385	24
1997	26	420	4	450	61
1998	18	217	0	235	18
1999	36	685	1	722	53
2000	83	232	5	320	17
2001	12	253	1	266	10
2002	75	367	2	444	8
2003	40	350	4	394	16
2004	14	361	5	380	22
2005	2	100	2	104	4
2006	13	131	1	145	7
2007	21	368	3	392	0
2008	12	50	0	62	0
2009	9	208	4	213	8

Survival

It is difficult to estimate the number of adult steelhead returning to the Clearwater River as a result of hatchery-reared steelhead released from DNFH. In the past, an estimated return to the river has been generated using a combination of sources. In addition to the fish collected at the hatchery trap, an estimated 37,709 clipped steelhead were harvested in the sport fishery within the Clearwater River (Carl Stiefel, IDFG, unpublished data). This harvest would be from a combination of DNFH and Clearwater Fish Hatchery (CFH) releases. Over the three release years (2005, 2006, 2007), fish from DNFH (combination of outplanted and direct-release groups) have made up around 78% (range 77.9 to 78.6%) of the marked hatchery steelhead released to the Clearwater River (Table 7). Applying this proportion directly to the harvest estimate results in an estimated sport harvest of 29,413 DNFH steelhead. Using a proportional breakdown by year class produced a similar estimated harvest of 29,400 DNFH steelhead. If harvest is location-specific (i.e. returning adult steelhead sorted themselves according to release site), then we would assume that steelhead harvested in the Clearwater River downstream from the NFCWR would be made up of a mixture of about 78% DNFH and 22% CFH steelhead, and that all steelhead harvested in the NFCWR, and about 26% of the fish harvested upstream from the NFCWR would be the returning adults from marked fish released from DNFH. Partitioning sport harvest in this way yields an estimated 27,772 returning steelhead from DNFH harvested in the CWR during 2008-2009 (Table 8). This last number is the harvest number we selected to use in Table 2 since we believe it most accurately reflects the distribution of returning steelhead in the CWR. An inherent source of error in this estimate is the assumption that all steelhead harvest in the Clearwater River are B-run Clearwater River fish, when it is likely that an unknown portion are hatchery A-run steelhead that have dipped into the Clearwater River and are then caught in the sport fishery

Table 7. Numbers of marked steelhead juveniles released from Dworshak National Fish Hatchery (DNFH) and IDFG Clearwater Fish Hatchery (CFH) during 2005, 2006, and 2007, and the proportion that were from Dworshak outplant and direct-release groups.

Release year	DNFH	DNFH	CFH	Total	% DNFH of total	
	outplants	direct release	all released	released	outplant	direct
2005	599,394	1,220,064	514,747	2,334,205	25.7	52.3
2006	689,940	1,206,565	537,632	2,431,137	28.3	49.6
2007	<u>611,751</u>	<u>1,312,486</u>	<u>524,444</u>	<u>2,448,681</u>	<u>25.0</u>	<u>53.6</u>
Total	1,901,085	3,739,115	1,576,376	7,216,576	26.3	51.8

Table 8. Estimated sport harvest of DNFH and CFH adult steelhead in the Clearwater River downstream, in, and upstream of the North Fork Clearwater River (NFCWR) and all locations combined. Ocean age proportion determined from CWT steelhead in the 2008-2009 rack return.

Ocean age	Ocean age proportion	Harvest by age class	Harvest by release group		
			DNFH outplant	DNFH direct	CFH outplant
Downstream of NFCWR					
3-ocean	0.006	137	35	72	30
2-ocean	0.915	20,938	5,935	10,379	4,625
1-ocean	0.079	<u>1,808</u>	<u>452</u>	<u>969</u>	<u>387</u>
Sub-total		22,883	6,422	11,419	5,042
In NFCWR					
3-ocean	0.006	22	0	22	0
2-ocean	0.915	3,386	0	3,386	0
1-ocean	0.079	<u>292</u>	<u>0</u>	<u>292</u>	<u>0</u>
Sub-total		3,701	0	3,701	0
Upstream of NFCWR					
3-ocean	0.006	67	36	0	31
2-ocean	0.915	10,179	5721	0	4,458
1-ocean	0.079	<u>879</u>	<u>473</u>	<u>0</u>	<u>406</u>
Sub-total		11,125	6,230	0	4,895
All locations combined					
Total		<u>37,709</u>	<u>12,652</u>	<u>15,120</u>	9,937
Total for DNFH steelhead			27,772		

The Nez Perce Tribal harvest estimate is not yet available. The highest estimated Tribal harvest from recent years was 1,470 adult steelhead during the 2005-2006 period. This value was used as a place-holder for our calculations.

The number of DNFH fish that are not harvested and did not return to a hatchery is also difficult to determine. In the past this value was estimated from the number of steelhead collected at Kooskia trap as a proportion of juveniles outplanted to Clear Creek, and extrapolating that proportion to all

DNFH outplanted fish. As 213 clipped steelhead were collected for 2009 broodstock, using this method produced an estimate of 473 unharvested DNFH steelhead in this system. Combining the estimates of the rack return, sport and tribal fishery harvests and unharvested fish, produces an estimate of 34,065 marked adult steelhead released from DNFH that returned to the Clearwater River during the 2008-09 migration season (Table 2). There is no way to place bounds on these estimates or verify the veracity of any of the component values except the number of fish collected at adult traps.

We attempted to make a separate estimate of hatchery steelhead returning to the Clearwater River based on previous radio telemetry evaluations (Keefer and Peery 2007). Four years of telemetry information are available, from 2000-01 to 2003-04 migration years. During those four years the percent of marked radio-tagged steelhead that passed Lower Granite Dam that were last detected in the Clearwater River ranged from a high of 36% in 2000-01 to low of 19% during 2003-04, and averaged 27.4% (Table 9). Applying this percentage to the 178,492 clipped steelhead counted at Lower Granite Dam during the 2008-09 migration season (<http://www.cbr.washington.edu/dart/dart.html>), produced an estimated return to the Clearwater River of 48,907 clipped steelhead, of which about 78%, or 38,147 fish, could potentially be from DNFH. Again, the error associated with this estimate, such as the number of A-run steelhead in the sample, was unknown.

Table 9. Number of marked steelhead counted at Lower Granite Dam during four migration seasons that coincided with radio telemetry monitoring, the proportion of radio-tagged steelhead that passed Lower Granite Dam that were subsequently detected in the Clearwater River, and an estimate of marked adult steelhead that entered the Clearwater River during those four migration seasons and during the 2008-2009 migration season based on the average percentage of radio-tagged (RT) steelhead in the Clearwater River.

Migration year	Lower Granite marked steelhead	% RT steelhead to Clearwater River	Estimated marked steelhead in Clearwater River
2000-01	94,953	36.1%	34,278
2001-02	219,811	32.3%	70,999
2002-03	164,455	22.0%	36,180
2003-04	128,341	19.2%	24,641
	Average	27.4%	
2008-09	178,492	27.4%	48,907

The 3-ocean returns in 2009 complete the returns from the 1,220,064 smolts directly released from Dworshak NFH in 2005. Total rack returns to DNFH for each age class in that brood year were 354 (11%) 1-ocean, 2,754 (86%) 2-ocean, and 85 (3%) 3-ocean fish (Table 10). The ten-year average return rate (1996-2005 release groups) was 0.362%. The mean hatchery rack return rate for the 1980-1999 was 0.480% (Figure 3).

Table 10. Rack return vs. direct release numbers for summer steelhead at DNFH, release years 1980-2006. Beginning in 2001 we operated the ladder intermittently to manage for broodstock collection, since the rack return is manipulated the total and percent return is displayed for comparison purposes only.

Release Year	Smolts Released	Returns			Total	Rack Return %
		1-Ocean	2-Ocean	3-Ocean		
1980	2,666,085	400	6,613	652	7,665	0.2875
1981	1,930,047	124	1,538	1,219	2,881	0.1493
1982	2,108,319	1,094	12,679	403	14,176	0.6724
1983	1,259,110	120	3,359	239	3,718	0.2953
1984	1,208,319	700	8,318	119	9,137	0.7562
1985	1,035,573	431	3,487	317	4,235	0.4090
1986	1,239,541	168	5,296	215	5,679	0.4582
1987	1,206,580	428	9,896	314	10,638	0.8817
1988	1,432,125	487	7,339	250	8,076	0.5639
1989	1,073,900	218	3,132	162	3,512	0.3270
1990	1,466,664	313	7,349	153	7,815	0.6699
1991	1,192,503	389	3,543	76	4,008	0.3361
1992	1,224,101	61	1,270	71	1,402	0.115
1993	1,217,990	48	4,005 ¹	83	4,136 ¹	0.3396
1994	1,153,417	384	2,537	38	2,959	0.2565
1995	1,213,577	349	3,308	87	3,744	0.3085
1996	1,377,435	253	4,976	69	5,298	0.3846
1997	1,361,034	356	2,225	96	2,677	0.1967
1998	1,228,944	588	5,745	177	6,510	0.5297
1999	1,249,237	570	6,226	129 ²	6,925	0.5543
2000	1,311,447	1,330	4,555 ²	101 ²	5,986	0.4564
2001	1,247,550	560 ²	2,988 ²	78 ²	3,626	0.2906
2002	1,365,823	678 ²	3,876 ²	34 ²	4,588	0.3359
2003	1,210,919	408 ²	2,837 ²	157 ²	3,402	0.2809
2004	1,202,055	372 ²	3,003 ²	32 ²	3,407	0.2834
2005	1,122,064	354 ²	2,754 ²	85	3,193	0.285%
2006	1,206,565	574 ²	3,789			
2007	1,312,486	461				
					1-ocean	0.032%
					2-ocean	0.250%
					3-ocean	0.008%

¹Does not include twenty unmeasured fish.

²Intermittent ladder operation for broodstock management.

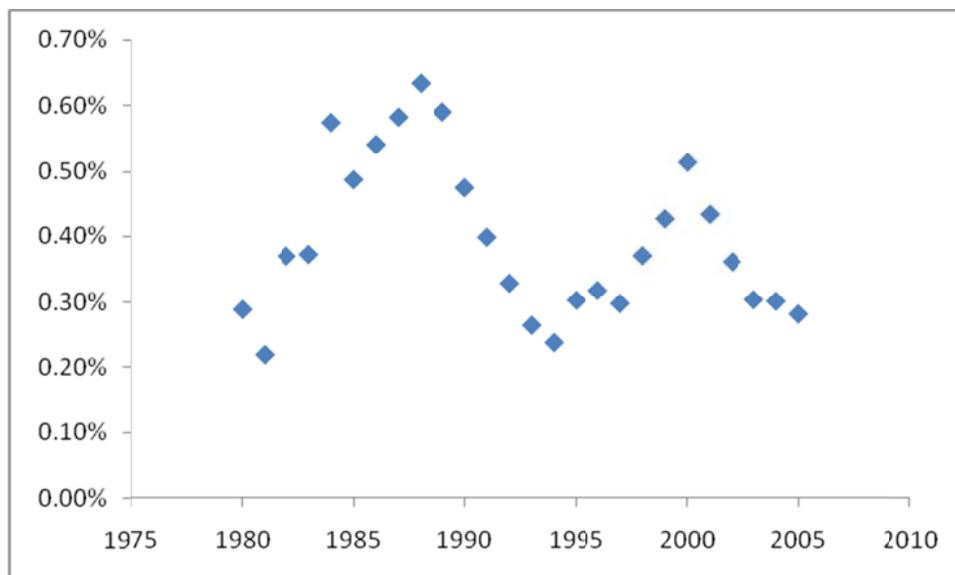


Figure 3. Three-year average of smot-to-adult returns for steelhead returning to DNFH. Year (x-axis) is year of release. Returns (y-axis) are cumulative 1-, 2-, and 3-ocean adults.

Adult Outplanting

When we trap more adult steelhead at the hatcheries than are necessary for broodstock, they are transported and released back to the Clearwater River, usually just upstream from the hatchery. A total of 2,412¹ (included 309 fish recaptured at DNFH) adults were outplanted from Dworshak and Kooskia NFHs in March and April (Table 11).

Table 11. Number, location, and purpose of adult summer steelhead outplanted Dworshak and Kooskia NFHs for supplementation in 2009.

Source	Release Location	Total
Dworshak NFH	Clearwater River	2,199
Kooskia NFH	SF Clearwater R	213
Total		2,412

PIT Tag Recoveries

Twenty fish with PIT tags were collected from the 2009 broodstock during trapping and spawning activities. Of these 20 fish, one was a 2-ocean steelhead tagged as a juvenile at DNFH; one was a 1-ocean; and one was a 2-ocean steelhead tagged as juveniles at CFH. Of the remaining 17 fish, 10 were PIT-tagged as juveniles at Lower Granite (n = 9) or Lower Monumental (n = 1) dams as part of the NOAA Fisheries transport and survival studies (eight 2-ocean and two 1-ocean fish). One

¹ Does not include steelhead collected and released during coho salmon broodstock collection.

PIT-tagged steelhead was a 2-ocean fish originally tagged as a smolt in the Touchet River, a tributary of the Walla Walla River. Six of the PIT-tagged steelhead were tagged as adults at Bonneville, Ice Harbor, and Priest Rapids dams.

Returning adult PIT-tagged steelhead from DNFH and CFH were detected at downstream Columbia and Snake River dams (Table 12). Overall, 23 DNFH and 153 CFH steelhead were detected at Bonneville Dam, which represents 0.60% of the PIT-tagged fish released during the 2005-2007 migration years from the two facilities. Seventeen of these DNFH fish and 113 of the CFH fish were detected at Lower Granite Dam, or 0.45% of release groups from both facilities. The detections by release year are shown in Table 11.

Table 12. Numbers of Dworshak National Fish Hatchery (DNFH) and Clearwater Fish Hatchery (CFH) PIT-tagged juvenile steelhead released and subsequently detected at Bonneville (BON) and Lower Granite (GRA) dams as returning migrating adults.

Release year	DNFH				CFH				Combined % at GRA
	PITs released	Adults at BON	Adults at GRA	% at GRA	PITS released	Adults at BON	Adults at GRA	% at GRA	
2005	1498	0	0	0%	11276	1	1	0.009%	0.008%
2006	1494	20	15	1.004%	11032	144	105	0.952%	0.958%
2007	1500	3	2	0.133%	2400	8	7	0.292%	0.231%

Coded-Wire Tag Recoveries

A total of 415 (9.5% of rack collection) adult steelhead collected at DNFH in 2009 contained coded-wire tags (CWT). Of these, 368 originated from DNFH and 47 originated from other known location(s) (Table 13). Of the fish from other known locations, 45 (95.7%) were CFH steelhead released to the SFCR (30 [66.8%] from Crooked River and 15 [33.3%] from Red House sites), and one each came from the Clearwater (unknown origin) and Touchet rivers.

Evaluation of Run Projection for 2009 and Forecast for 2010

2009 Steelhead Prediction.

The 2009 run prediction and actual rack return by age class is listed in Table 14. Our 2009 prediction underestimated the actual rack return by approximately 800 fish. The prediction of 1-ocean component was estimated from a regression equation that included number of smolts released the previous year, mean flow in the Snake River during May of the year smolts were release, and an index of the alongshore current. The 2-ocean regression was primarily driven by the number of smolts release two years previously and the number of jacks that returned the previous year. The prediction for 3-ocean returns was based the number of smolts released three years previously and the Pacific decadal oscillation (PDO; <http://jisao.washington.edu/pdo/PDO.latest>) during May of the year of ocean entry. PDO is related conditions that promote upwelling and ocean productivity. Using a separate set of regression models, we predicted a little over 33,000 DNFH steelhead would return to the Clearwater River during 2008-2009. The actual

Table 13. Summary of coded-wire tag recoveries for adult summer steelhead in the Dworshak and Kooskia NFH racks, 1987-2008.

Year	Total Recoveries	Recoveries of Dworshak Stock	Recoveries of Marks from Strays
1987 ⁴	397	388 ¹	9
1988	50	44	6
1989	284	279 ¹	5
1990	587	571 ¹	16
1991	738	738	0
1992	325	322 ¹	3
1993	511	508	3
1994	238	234	4
1995	108	108 ¹	0
1996	330	326 ²	4
1997	342	341 ²	1
1998	378	368 ³	10
1999	446	445 ³	1
2000	378	375	3
2001	405	403	2
2002	637	630	7
2003 ⁴	1012	1011	1
2004 ⁴	713	708	5
2005 ⁴	285	277	8
2006 ⁴	577	574	3
2007 ⁴	229	225 ³	4
2008 ⁴	301	247	32 ³
2009 ⁴	415	368	47 ³

¹Includes NMFS transportation study marks. ²Includes NMFS transportation study marks and Clearwater Hatchery marks from the South Fork Clearwater River releases. ³Includes Clearwater Hatchery marks from South Fork Clearwater and Clear Creek releases. ⁴Intermittent ladder operation for broodstock management.

Table 14. Comparison of predicted and actual adult rack returns for summer steelhead at Dworshak NFH, 2008-2009.

Ocean Age Class	Predicted rack	Actual rack	Predicted CWR	Actual CWR
1-Ocean	588	461	3,168	3,620
2-Ocean	2,881	3,768	29,376	29,753
3-Ocean	35	84	466	667
Total	3,504	4,350	33,010	34,065

number estimated to have returned was approximately 1,000 higher than the predicted value (Table 14). Predicted return of 1-ocean steelhead were derived from a regression model containing the count of adult steelhead at Ice Harbor Dam from the previous year and two measures of ocean condition; May PDO during the year of ocean entry and the multivariate ENSO (El Nino Southern Oscillation) Index (MEI; <http://www.esrl.noaa.gov/psd/people/klaus.wolter/MEI/mei.html>). Similar to PDO, MEI is a measure of ocean conditions related to productivity. MEI is a composite of six variables: sea-level pressure, zonal and meridional components of the surface wind, sea surface temperature, surface air temperature, and total cloudiness fraction of the sky. Although MEI and PDO are both related to ocean conditions the values used in the regression were not autocorrelated and so could be included in this model.

2010 Steelhead Run Prediction.

In 2008-09, an estimated 34,065 DNFH hatchery B-run steelhead returned to the Clearwater River, of which 4,350 (12.8%) were collected at DNFH as broodstock fall and spring 2008-09. Numbers of hatchery steelhead to return to the CWR in 2009-10 were estimated to be 35,365 using the same model described above. If the proportional composition of males and females, and for 1-, 2-, and 3-ocean fish are similar as for the 2008-09 run, we would anticipate about 4,511 (13%) collected at the DNFH using intermittent trapping. The proportional breakdown by age and sex is shown in Table 15. Figure 4 illustrates relationship between 1-, 2-, and 3-ocean returns and the best univariate predictor for numbers of adult DNFH steelhead returning to the CWR.

Table 15. Predicted steelhead returns to Clearwater River and DNFH rack, 2009-2010 based on estimated return of 35,365 adult hatchery B steelhead to the Clearwater River and 4,511 to the DNFH trap.

	Clearwater River			DNFH Rack		
	1-Ocean	2-Ocean	3-Ocean	1-Ocean	2-Ocean	3-Ocean
Male	3,044	8,628	0	396	1,089	0
Female	961	22,185	547	125	2,800	68

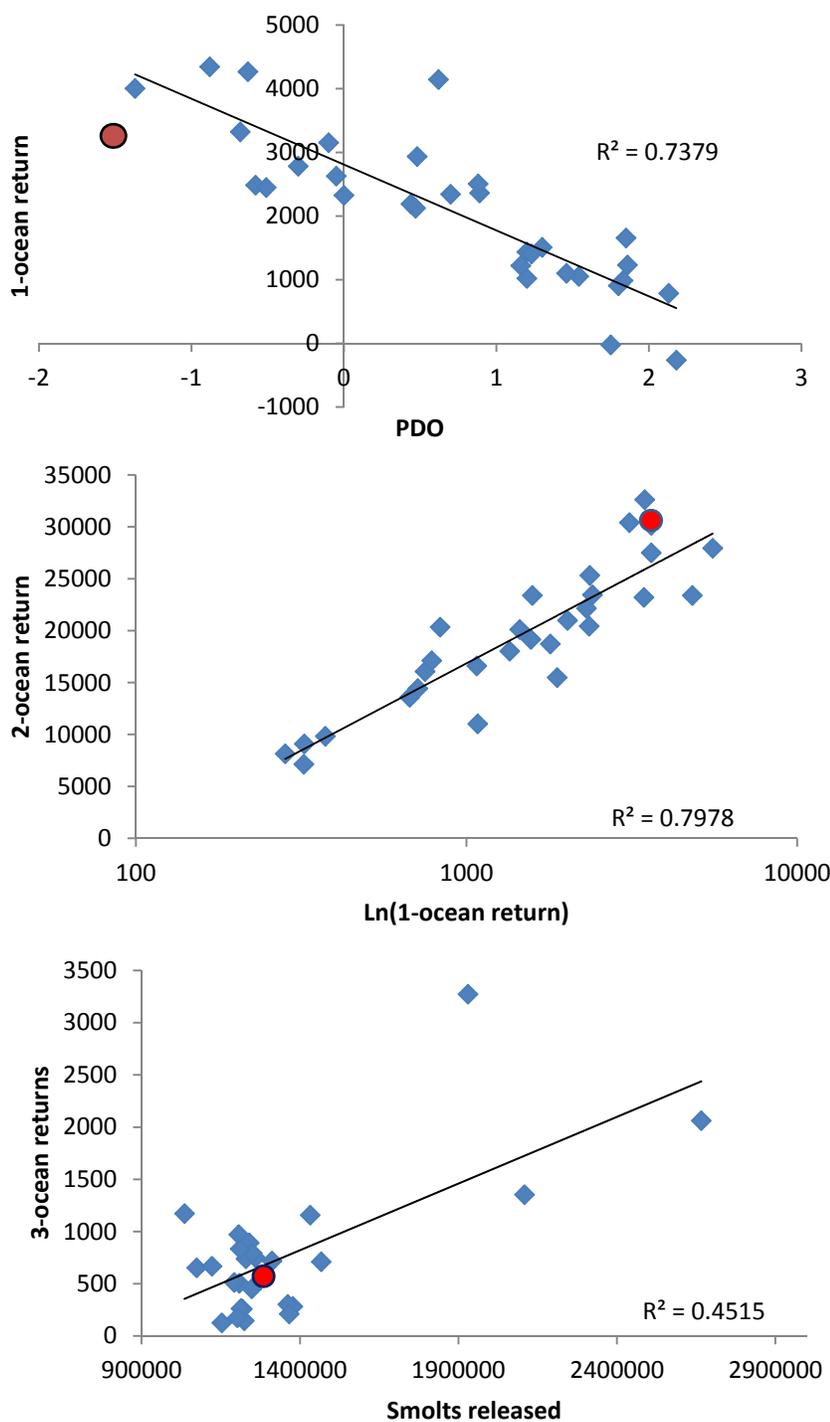


Figure 4. Regressions of 1- (top), 2- (middle), and 3-ocean (bottom) DNFH steelhead returning to the CWR plotted against the variable of greatest influence in multivariate predictive models. Circle represents predicted return for each ocean age class for 2009-10. R^2 values are for univariate models only.

Juvenile Releases - 2009

During the spring of 2009, a total of 1,798,874 juvenile steelhead from broodyear 2008 were released. The largest group (1,068,367; 59%) were released directly from the hatchery into the North Fork Clearwater River. The remainder were split between three outplant sites within the South Fork Clearwater River: American River, Red House Hole and Newsome Creek and one site in the mainstem Clearwater River above the South Fork (Clear Creek). Steelhead averaged 205 mm in length and 83 g in weight at release. The Clearwater River at time of release averaged 37.2 kcfs and 6.4°C (Figure 5). Ocean conditions at the time smolts would be arriving (e.g. mean May PDO) were favorable, suggesting higher than average survival and returns of 1- and 2-ocean adults in the future.

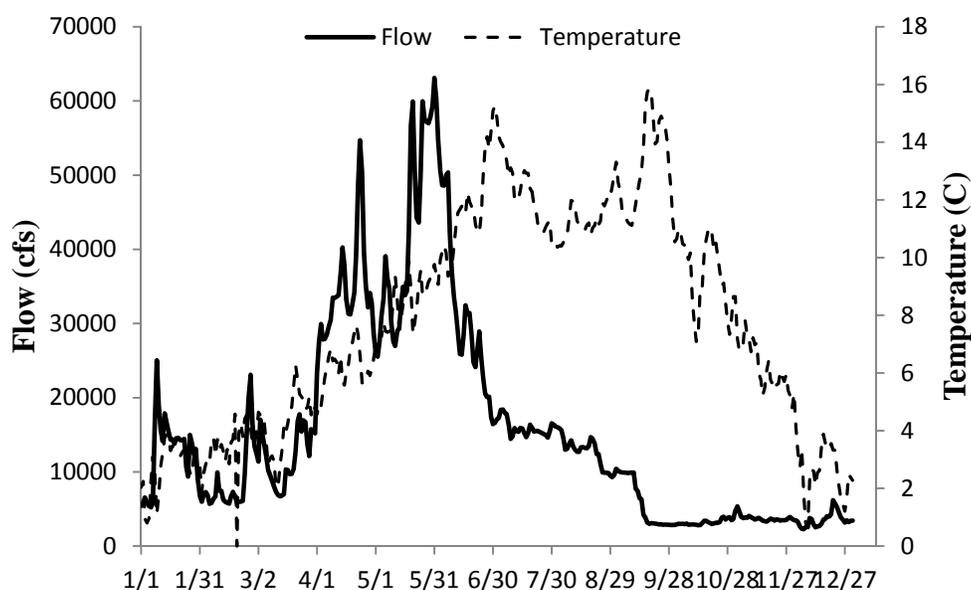


Figure 5. Flow (cfs) and water temperature of the Clearwater River near the town of Spalding, ID 2009. Source: http://www.cbr.washington.edu/dart/headwater_com.html.

An estimated 29,817 of the steelhead juveniles released spring 2009 contained passive integrated transponder (PIT) tags to be used to track travel times and survival, 69% of which were with the direct release group. The remaining PIT-tagged steelhead were split between those fish released into the South Fork Clearwater River and Clear Creek. All steelhead were released mid-April 2009. Estimates of survival for PIT-tagged fish were calculated using a Cormack Jolly Seber mark-recapture estimator (SURPH Model; CQS 1994). Survival for steelhead was estimated to be 83.2% (standard error [SE] = 0.4%) to Lower Granite Dam and 55.8% (SE = 14.8%) to Bonneville Dam. Survival to Lower Granite and Bonneville dams for outplanted steelhead were comparable to the direct released fish at 78.9-83.1% (SE = 1.0%) and 34.0-62.9% (SE = 14.1-42.7%), respectively. The harmonic mean travel time for direct-released steelhead was 6.3 d (SE = 0.03) to Lower Granite Dam and 19.9 d (SE = 0.3) to Bonneville Dam. Harmonic mean travel times for outplanted steelhead to Lower Granite and Bonneville dams were 8-11 d (SE = 0.1) and 22-24 d (SE = 0.6), respectively.

References Cited

- CQS (Center for Quantitative Science). 1994. Statistical survival analysis of fish and wildlife tagging studies SURPH. Developed by the Center for Quantitative Sciences, School of Fisheries, University of Washington, Seattle WA, for the Bonneville Power Administration, Portland, OR.
- Keating, J.F. 1958. Clearwater River fisheries investigations, IV. Steelhead trout tagging study. Idaho Department of Fish and Game, Boise, Project F 15R.
- Keefer, M., and C. Peery. 2007. An analysis of adult radio-tagged steelhead escapement in the Snake River upstream from Lower Granite Dam. Letter Report to U.S. Army Corps of Engineers, Portland and Walla Walla Districts.
- Pettit, S.W. 1976. Dworshak fisheries studies, Job 2. Evaluation of game and rough fish populations below Dworshak Dam and relationship to changes in water quality. Idaho Department of Fish and Game, Boise, Performance report.
- Whitt, C.R. 1954. The age, growth, and migration of steelhead trout in the Clearwater River, Idaho. Master's thesis. University of Idaho, Moscow.